Entergy

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Site Vice President

NL-10-111

November 8, 2010

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Stop O-P1-17
Washington, D.C. 20555-0001

SUBJECT: Licensee Event Report # 2010-002-00, "Manual Reactor Trip Due to a Cooling Water Leak in the Main Generator Exciter Air Cooler"
Indian Point Unit No. 3
Docket No. 50-286
DPR-64

Dear Sir or Madam:

Pursuant to 10 CFR 50.73(a)(1), Entergy Nuclear Operations Inc. (ENO) hereby provides Licensee Event Report (LER) 2010-002-00. The attached LER identifies an event where the reactor was manually tripped, which is reportable under 10 CFR 50.73(a)(2)(iv)(A) . As a result of the reactor trip, the Auxiliary Feedwater system was actuated which is also reportable under 10 CFR 50.73(a)(2)(iv)(A). This condition was recorded in the Entergy Corrective Action Program as Condition Report CR-IP3-2010-02682.

There are no new commitments identified in this letter. Should you have any questions regarding this submittal, please contact Mr. Robert Walpole, Manager, Licensing at (914) 734-6710.

Sincerely,

JEP/cbr

cc: Mr. William Dean, Regional Administrator, NRC Region I
NRC Resident Inspector's Office, Indian Point 3
Mr. Paul Eddy, New York State Public Service Commission
LEREvents@inpo.org

IE22
NRR

NRC FORM 366 (9-2007) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES: 8/31/2010

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

1. FACILITY NAME:	2. DOCKET NUMBER	3. PAGE
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4. TITLE: Manual Reactor Trip Due to a Cooling Water Leak in the Main Generator Exciter Air Cooler

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV. NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
9	09	2010	2010-	002 -	00	11	8	2010	FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

1

10. POWER LEVEL

100%

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☒ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER *(Include Area Code)*
Mary Troy, Senior Engineer, Programs & Component Engineering	(914) 734-6837

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
E	KG	HX	W120	Y					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

16. ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced type written lines)*

On September 9, 2010, during full power operations, a water leak in the main generator exciter housing was observed by an operator during rounds and the condition reported to the control room. Operations initiated closure of the Exciter heat exchanger inlet cooling water valve (SWT-25-2) in order to isolate the B section of the exciter cooler. Almost immediately the leak worsened confirming that the leak was in the A section of the exciter cooler. Water was observed to be pooling in the Permanent Magnet Generator section of the exciter and a manual reactor trip was initiated. All control rods fully inserted and all required safety systems functioned properly and the plant was stabilized in hot standby. There was no radiation release. No Emergency Diesel Generator actuated as offsite power remained available. The Auxiliary Feedwater System automatically started as expected due to Steam Generator low level from shrink effect. The direct cause of the event was a leak in the 31 Exciter Air Cooler due to the failure of an Admiralty Brass tube (S-1-11) from erosion and corrosion. The root cause was component monitoring was less than adequate. The current Eddy Current Testing, Tube Air Pressure Testing, and visual inspection techniques do not effectively identify degradation in the tube sheet area. Corrective actions include: Inspections and testing of both exciter coolers was performed and 194 tube end sleeves were installed in both ends of all unplugged tubes of the 31 and 32 Exciter Air Cooler (tube S-1-11 was plugged and two other tubes had previous plugging), guidance will be developed for inclusion in a procedure for high risk heat exchangers with Admiralty Brass tubes to proactively sleeve tube ends as a mitigation strategy. The event had no effect on public health and safety.

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NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

Note: The Energy Industry Identification System Codes are identified within the brackets {}.

DESCRIPTION OF EVENT

On September 9, 2010, during 100% steady state reactor power, a service water (SW) {KG} leak in the southeast corner of the main generator exciter {TL} housing was observed by an operator during rounds and the condition reported to the Control Room {NA}. Since it was not obvious which cooler was leaking, Operations initiated closure of the Exciter heat exchanger {HX} inlet cooling water valve (SWT-25-2) in order to isolate the B section of the Exciter Air Cooler {HX} east side. Almost immediately the leak worsened confirming that the leak was in the A section of the Exciter Air Cooler. Water was observed to be pooling in the Permanent Magnet Generator (PMG) section of the exciter and a manual reactor trip was initiated at approximately 21:29 hours. All control rods {AA} fully inserted and all required safety systems functioned properly. Unexpected equipment performance was a trip of the 34 Reactor Coolant Pump {P} on fast bus transfer, low RCP {AB} seal {SEAL} return flow, and a high level alarm {LA} for the 34 RCP stand pipe. The plant was stabilized in hot standby with decay heat being removed by the main condenser {SG}. There was no radiation release. No Emergency Diesel Generator {EK} actuated as offsite power remained available. The Auxiliary Feedwater (AFW) System {BA} automatically started as expected due to Steam Generator low level from shrink effect. The event was recorded in the Indian Point Energy Center corrective action program (CAP) as condition report CR-IP3-2010-02682. A post transient evaluation was initiated and completed on September 10, 2010.

Prior to the trip, a leak in the Exciter housing was first suspected on September 7, 2010, when an operator making rounds reported difficulty seeing into the Exciter housing because of fogging of the housing windows. The condition was recorded as CR-IP3-2010-02642. On September 8, 2010 the air cooler access covers on the Exciter housing were removed for inspection of coolers and piping. A visual inspection was performed and no active leakage was found. Additionally, the exciter doors were opened and a visual inspection was performed inside the exciter housing. The exciter assembly is cooled by a closed air system and two heat exchangers (31 and 32 Exciter Air Cooler) located in the north and south ends of the enclosure. A fan {FAN} is installed on the exciter shaft to provide the means of air circulation. Each cooler consists of two sections of tubes (25 tubes per section) cooled by SW from the non-essential header. SW enters the cooler through SWT-25 valves {V} and exits through SWT-26 valves. Outlet valves are adjusted to equalize flow through the heat exchangers. Each cooler consists of two parallel water circuits in one shell, each with separate tube plates and water chambers. The 31 Exciter Air Cooler is installed vertically while the 32 Exciter Air Cooler is installed horizontally. SW enters the cooler absorbing heat from the air entering the shell, and exits via the water outlets. The inlet and reverse water chambers are made of cast ductile iron, partitioned to provide water passes and bolted to their respective tube plates. The Exciter Air Cooler tubes are made of Admiralty Brass with external spirally wound copper fins. The tube plates are made of Muntz metal (a form of brass composed of copper, zinc and a trace of iron). The 31 Exciter Air Cooler is air to SW heat exchanger {HX}, model number 16-A-8481, manufactured by Westinghouse {W120}.

After the trip, the Exciter Air Cooler inlet and outlet heads were removed. A Tube Air Pressure Test and a visual inspection was performed. Air pressure testing on each tube identified tube S-1-11 in the 31 Exciter Air Cooler as having a leak. A boroscope inspection was performed but no source of the leakage was identified. Further visual inspection identified a through-wall defect just beyond the tube sheet for the tube responsible for the leakage.

Following the initial inspection additional testing was performed on the 31 and 32 Exciter Air Coolers using Eddy Current Testing (ECT) to determine the general wall loss in each tube and whether any tubes would need to be plugged because of severe degradation. Corrosion and pitted tube ends indicated the need for sleeving as a precautionary measure. A total of 194 tube end sleeves were installed in both ends of all unplugged tubes (tube S-1-11 in the 31 Exciter Air Cooler was plugged because of the newly identified hole. Two tubes (N-1-11 in the 31 Exciter Air Cooler, and U-2-5 in the 32 Exciter Air Cooler) were previously plugged and did not require sleeving. The ECT did not identify any other tubes with severe wall loss that would require plugging.

Every two years during refueling outages the tube side of each of the Exciter Air Coolers is cleaned and inspected (procedure 3-HTX-010-MTG) to include the performance of 100% ECT (procedure 0-HTX-400-GEN). Should either of the procedures recommend it due to potential wall thinning, through wall defects, or indications in the tubes, a Tube Air Pressure Test is performed. However, although 100% of the tubes are examined by ECT, it does not effectively identify wall thinning in the tube sections at the tube sheet area. Additionally, Tube Air Pressure testing will only identify where there already is a through wall leak as it is not a predictive method. Because ECT and Tube Air Pressure Testing does not identify degradation in the tube sheet area, visual inspections are performed each refueling outage. The outage inspections are for erosion, corrosion, pitting and for debris/sludge that could affect SW flow and tube degradation rates. The Admiralty brass tubes are prone to erosion and corrosion from the brackish river water used for cooling (SW).

An extent of condition (EOC) review determined that there are other heat exchangers susceptible to potential tube failure due to the adverse effects on copper alloy heat exchangers from brackish cooling water. The following heat exchangers with admiralty Brass and copper based tube material are applicable but only those heat exchangers whose failure could result in a plant trip are included: 1) unit 2 hydrogen coolers, 2) unit 2 main turbine lube oil coolers, 3) unit 3 isophase coolers, 4) unit 3 main turbine lube oil coolers, 5) unit 3 air side seal oil coolers, 6) unit 3 hydrogen side seal oil coolers, 7) unit 2 and 3 main boiler feedwater pump lube oil coolers.

The Cause of Event

The direct cause of the event was a leak in the 31 Exciter Air Cooler due to the failure of an Admiralty Brass tube (S-1-11) from erosion and corrosion. The root cause was component monitoring was less than adequate. There was no clear or specified acceptance criteria to identify at which point further mitigation actions should be implemented. ECT, Tube Air Pressure testing and visual inspection techniques do not effectively identify degradation in the tube sheet area.

Corrective Actions

The following corrective actions have been or will be performed under the Corrective Action Program (CAP) to address the causes of this event.

Exciter Air Cooler inlet and outlet heads were removed and a Tube Air Pressure Test and a visual inspection was performed. Air pressure testing on each tube identified tube S-1-11 as having a leak. A boroscope inspection was performed but no source of the leakage was identified. Further visual inspection identified a through-wall defect just beyond the tube sheet for tube S-1-11. Additional testing was performed using Eddy Current Testing (ECT) to determine the general wall loss in each tube.

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

- A total of 194 tube end sleeves were installed in both ends of all unplugged tubes of the 31 and 32 Exciter Air Cooler (tube S-1-11 in the 31 Exciter Air Cooler was plugged because of the newly identified through wall defect (tube N-1-11 in the 31 Exciter Air Cooler, and tube U-2-5 in the 32 Exciter Air Cooler were previously plugged and did not require sleeving).
- Guidance will be developed for inclusion in a procedure for high risk heat exchangers with Admiralty Brass tubes to proactively sleeve tube ends as a mitigation strategy.
- A failure analysis will be performed on tubes after removal of the tube bundle in the next refueling outage.
- The Exciter Air Cooler heat exchanger tube bundles will be replaced in the next refueling outage.
- Guidance will be developed and incorporated into applicable procedures to provide clear acceptance criteria for visual inspections. Included will be a requirement for a drying period prior to visual inspections of the tubes.

Event Analysis

The event is reportable under 10CFR50.73(a)(2)(iv)(A). The licensee shall report any event or condition that resulted in manual or automatic actuation of any of the systems listed under 10CFR50.73(a)(2)(iv)(B). Systems to which the requirements of 10CFR50.73(a)(2)(iv)(A) apply for this event include the Reactor Protection System (RPS) including RT and AFWS actuation. This event meets the reporting criteria because a manual RT was initiated at 21:29 hours, on September 9, 2010, and the AFWS actuated as a result of the RT. The RT did not result in the failure of any primary system to function properly. Therefore, there was no safety system functional failure reportable under 10CFR50.73(a)(2)(v). On September 10, 2010, at 00:29 hours, a 4-hour non-emergency notification was made to the NRC for an actuation of the reactor protection system while critical and included an 8-hour notification under 10CFR50.72(b)(3)(iv)(A) for a valid actuation of the AFW System (Event Log # 46241).

Past Similar Events

A review was performed of the past three years of Licensee Event Reports (LERs) for unit 3 events that involved a RT due to a leak in the exciter. No recent LERs were identified however, a similar event occurred on June 10, 2005 and reported in LER-2005-004. The cause of the leak identified for LER-2005-004 was a displaced/extruded gasket on the mating surface of the 32A Exciter cooler due to over tightening of the head bolting. The root cause was omission of relevant information in the maintenance procedure and inadequate training for gasketed joint installation. The cause of the event reported in LER-2005-004 was not the same as this event therefore the corrective actions would not have prevented this event.

Safety Significance

This event had no effect on the health and safety of the public.

There were no actual safety consequences for the event because the event was an uncomplicated reactor trip with no other transients or accidents. Required safety systems performed as designed when the RT was initiated. The AFWS actuation was an expected reaction as a result of low SG water level due to SG void fraction (shrink), which occurs after a RT and main steam back pressure as a result of the rapid reduction of steam flow due to turbine control valve closure.

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There were no significant potential safety consequences of this event under reasonable and credible alternative conditions. The manual actuating devices are independent of the automatic trip circuitry and are not subject to failures which might make the automatic circuitry inoperable. Without a manual RT the loss of generator excitation would actuate a generator and turbine trip (TT). The generator trip logic produces a TT signal for any generator trip signal.

The analysis in UFSAR Section 14.1.8 concludes an immediate RT on TT is not required for reactor protection. A RT on TT is provided to anticipate probable plant transients and to avoid the resulting thermal transient. If the reactor is not tripped by a TT, the over temperature delta temperature (OTDT) or over power delta temperature (OPDT) trip would prevent safety limits from being exceeded. This event was bounded by the analyzed event described in FSAR Section 14.1.8, Loss of External Electrical Load. The response of the plant is evaluated for a complete loss of steam load or a TT from full power without a direct RT. For a TT, the reactor would be tripped directly (unless below the power Permissive 8 set point 35%) from a signal derived from the turbine autostop oil pressure and turbine stop valves. This event is analyzed as a TT from full power as this bounds both events. The analysis shows that the plant design is such that there would be no challenge to the integrity of the reactor coolant system or main steam system and no core safety limit would be violated.

For this event, rod control was in automatic and all rods inserted upon initiation of the RT. The AFWS actuated and provided required FW flow to the SGs. RCS pressure remained below the set point for pressurizer PORV or code safety valve operation and above the set point for automatic safety injection actuation. Following the RT, the plant was stabilized in hot standby. As a result of the plant trip the 34 RCP tripped during fast bus transfer from unit power to offsite power. The 34 RCP seal return flow indicated low or zero flow and a high level alarm for the stand pipe. Subsequent investigation determined that the cause of the 34 RCP trip was a result of a slow breaker pole at a timing level that actuated neutral monitoring relay and the 34 RCP #2 seal had become misaligned directing seal return flow to the Reactor Coolant Drain Tank (RCDT).